Remarks

Thorough examination by the Examiner is noted and appreciated.

The Specification and the claims have been amended to overcome Examiners Section 112 rejection.

No new matter has been added.

Claim Rejections under 35 USC 112

Claims 1-3, 7-13, 17 and 19-26 stand rejected under 35 U.S.C. 112, first paragraph, as failing comply with the written description requirement.

Examiner contends that the limitation in claim 1, 13, and 17, the word "non-supercritical" in the limitation "mixing a solvent with said cleaning fluid to form a non-supercritical cleaning fluid mixture;" is not described in the Specification in such a way as to reasonable convey to one skilled in the art that the inventors, at the time of the invention, had possession of the claimed invention. Examiner further notes there is no explicit support of the term "non-supercritical" in the

Specification.

Examiner has not explained how or why one skilled in the art would not understand that Applicants have disclosed and taught in the Specification that the cleaning mixture is formed in a non-supercritical state (liquid or gaseous) and then introduced into a cleaning chamber where it is then transformed into a supercritical state.

See e.g.:

[0030] After the substrate 32 is placed on the substrate support 30 and the cleaning fluid 14 is provided in the cleaning fluid holding tank 12, **the cleaning chamber 28 is set at the temperature and pressure conditions that are required to transform the cleaning fluid 14 from the liquid or gaseous state to the supercritical fluid state**, and these threshold temperature and pressure conditions vary according to the cleaning fluid used, as shown in Table I. By operation of the pump 18, the cleaning fluid 14 is then pumped from the cleaning fluid holding tank 12, through the holding tank outlet conduit 16 and into the mixing conduit 20. Simultaneously, by operation of the pump 24, the solvent 23 is distributed from the solvent holding tank 22 and into the mixing conduit 20. **As they are pumped through the mixing conduit 20, the cleaning fluid 14 and the solvent 23 mix together to define a cleaning fluid/solvent mixture 26 that enters the cleaning chamber 28.**

[0031] **As the cleaning fluid/solvent mixture 26 enters the cleaning chamber 28, the cleaning fluid therein reaches the supercritical temperature and pressure which transform it from the liquid or gaseous state to the supercritical state, at which point the cleaning fluid forms a supercritical cleaning fluid 34.**

Thus, it would be clear to one of ordinary skill that the liquid or gaseous state of the cleaning fluid mixture which is **transformed into the supercritical state** within the cleaning chamber **is in a non-supercritical state (gaseous or liquid) prior to its transformation into a supercritical state.**

Applicants respectfully refer Examiner to the following relevant portions of the MPEP and the case law:

> **ADEQUACY OF WRITTEN DESCRIPTION**
> ***A. Read and Analyze the Specification for Compliance with 35 U.S.C. 112, para. 1***
> Office personnel should adhere to the following procedures when reviewing patent applications for compliance with the written description requirement of 35 U.S.C. 112, para. 1. The examiner has the initial burden, after a thorough reading and evaluation of the content of the application, of **presenting evidence or reasons why a person skilled in the art would not recognize that the written description of the invention provides support for the claims.** There is a strong presumption that an adequate written description of the claimed invention is present in the specification as filed, *Wertheim*, 541 F.2d at 262, 191 USPQ; however, with respect to newly added or claims, applicant should show support in the disclosure for the new or amended claims.

> "[I]n considering the disclosure of a reference, it is proper to take into account **not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom."** *In re Preda*, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968)

See MPEP, 8th Ed, Section 2163 (I)

While there is **no *in haec verba* requirement**, newly added claim limitations must be supported in the specification through **express, implicit, or inherent disclosure.**

See MPEP, 8th Ed, Section 2163 (I) (B)

The fundamental factual inquiry is whether the specification conveys with reasonable clarity to those skilled in the art that, as of the filing date sought, applicant was in possession of the invention as now claimed. See, e.g., *Vas-Cath, Inc.*, 935 F.2d at 1563-64, 19 USPQ2d at 1117.

Possession may be shown in many ways. For example, possession may **be shown by describing an actual reduction to practice of the claimed invention.** Possession may also be shown by a clear depiction of the invention in detailed drawings or in structural chemical formulas which permit a person skilled in the art to clearly recognize that applicant had possession of the claimed invention. An adequate written description of the invention may be shown by any description of sufficient, relevant, identifying characteristics so long as a person skilled in the art would recognize that the inventor had possession of the claimed invention. See, e.g., *Purdue Pharma L.P. v. Faulding Inc.*, 230 F.3d 1320, 1323, 56 USPQ2d 1481, 1483 (Fed. Cir. 2000)

Applicants respectfully contend that one of ordinary skill would clearly understand that Applicants invention encompasses and **explicitly, implicitly and inherently refers to** a non-supercritical state of the **gaseous or liquid** cleaning mixture

(gaseous or liquid is **explicitly, implicitly and inherently** non-supercritical) prior to entering the cleaning chamber by **explicitly** disclosing the **transformation** of the cleaning mixture to **the supercritical state** within the cleaning chamber. That is, it is explicit that to transform something into a supercritical state, it must be in a non-supercritical state (absence of a supercritical state) prior to its transformation to a supercritical state.

Thus, Examiner has failed to make out a prima facie case that one of ordinary skill in the art would not have recognized or understood that Applicants cleaning mixture **is in a non-supercritical state prior to being transformed into a supercritical state within the cleaning chamber.**

Nevertheless, Applicants have further amended their Specification and claims to overcome Examiners rejection to further prosecution on the merits.

Claim Rejections under 35 USC 103

1. Claims 1-3, 7-9 and 21 stand rejected under 35 U.S.C. §103 (a) as being unpatentable over Inoue et al. (US 6, 962,161).

Inoue et al. disclose a cleaning process including **continuous flow** of **supercritical carbon dioxide cleaning fluid** through a pressurized cleaning chamber (see Abstract). The carbon dioxide is **transformed** into a supercritical state together with additives and a co-solvent **upstream of and prior to delivery to the high-pressure continuous flow process chamber (cleaning chamber)** (see col 3, lines 4-12; lines 57-62; col 4, lines 52-54). Inoue et al. disclose that in a third stage a mixture of additives and co-solvents **are added to the supercritical carbon dioxide in mixing unit 15** (by closing valve 10 following delivery of **only supercritical carbon dioxide** heated in heater 8 to the chamber 1 in a second stage) (see Figure 1) where the mixture of carbon dioxide, additives, and a co-solvent is then **further heated if necessary** (i.e., if necessary **to maintain or reachieve** supercriticality) (col 5, lines 9-27). Thus, Inoue et al. teaches that the addition of additives and co-solvent in the mixing tank 15 **may cause supercriticality to disappear,** in which case, the supplied cleaning mixture **is heated by heater 16 as necessary to reachieve supercriticality** prior to being delivered to the high pressure chamber (see col 5, lines 22-27).

The process of achieving supercriticality prior to delivery

to the **pressurized continuous flow cleaning chamber** is further explained in the rinsing stage (col 7, lines 29-31) where Inoue et al. **also teach (like the third stage)** that carbon dioxide and a co-solvent (no other additives) **are made supercritical by heater 16 prior to delivery to the continuous flow cleaning chamber** (col 7, lines 31-37).

Note that the flow path of the mixture (cleaning fluid) is from the mixing unit 15 through heater 16, and Inoue et al. nowhere teach that the cleaning fluid is transformed from a non-supercritical fluid to a supercritical fluid within the **pressurized continuous flow cleaning chamber. Indeed, such a process would make inoperable the continuous flow process in a supercritical state of Inoue et al.**

Inoue et al. further disclose the use of "fluorides" as additives and disclose "fluorides" further containing a carbon atom (col 5, lines 54-col 6, line 4). Inoue also discloses the use of methanol, ethanol, and isopropanol as co-solvents (col 6, lines 20-22).

Thus Inoue et al. fail to disclose several elements of Applicants invention, including those elements in **bold type**:

"A method of cleaning substrates, comprising the steps of:

providing a cleaning fluid;

mixing a solvent with said cleaning fluid to form a cleaning fluid mixture in a non-supercritical state;

delivering said cleaning fluid mixture in said non-supercritical state to a cleaning chamber;

forming a supercritical cleaning fluid from said cleaning fluid mixture in said non-supercritical state in said cleaning chamber; and

contacting the substrate with said supercritical cleaning fluid in said cleaning chamber."

Examiner argues that since Inoue et al. disclose that during the addition of additives to the supercritical carbon dioxide in the mixing tank upstream of the cleaning chamber, that the supercritical state may disappear, in which case it is

reheated to maintain supercriticality, that "Inoue et al. disclose that the mixture is non-supercritical state after mixing in the mixing chamber (15). One of ordinary skill in the art would mix the cleaning fluid and solvent in non-supercritical state and the change the mixture into a supercritical state for cleaning the substrate in the chamber".

However, Examiner points to no teaching or suggestion in Inoue et al. or elsewhere to do what Examiner contends one of ordinary skill would do.

Examiner attempts to find motivation in the teaching of Inoue et al. that since it is difficult to dissolve particular additives in supercritical carbon dioxide, that a co-solvent should be used a dissolution auxiliary to achieve a homogeneous supercritical mixture (making additives and supercritical carbon dioxide compatible in the mixing chamber upstream of the cleaning chamber) (see col 6, lines 12-20; col 5, lines 24-27).

Inoue et al. nowhere teach or suggest that a more homogenous mixture might be obtained by mixing the cleaning fluid (including additives) in the non-supercritical state prior to transforming to a supercritical state within the cleaning chamber as Examiner appears to suggest, rather Inoue et al. teach a process that

operates by a different principle of operation than Applicants method(i.e. **supplying a continuous flow of supercritical state cleaning fluid from the mixing chamber through the cleaning chamber)** (see col 3, lines 9-21).

"A prior art reference must be considered in its entirety, i.e., as a whole including portions that would lead away from the claimed invention." *W.L. Gore & Associates, Inc., Garlock, Inc., 721 F.2d, 1540, 220 USPQ 303 (Fed Cir. 1983), cert denied, 469 U.S. 851 (1984).*

Examiner can point to no teaching or suggestion in Inoue et al. where Inoue et al. teaches mixing the cleaning fluid in a non-supercritical state and then transforming it to s supercritical state within the cleaning chamber.

Moreover Examiner ignores the fact that any modification of Inoue et al. in an effort to achieve Applicants invention (i.e., transforming a cleaning fluid mixture in a non-supercritical state to a supercritical state within the cleaning chamber) **is impermissible as a matter of law** since it would **change the principle of operation** of the method of Inoue et al. (i.e. **supplying a continuous flow of supercritical state cleaning fluid**

from the mixing chamber through the cleaning chamber) and **make it unsuitable for its intended purpose** (i.e. **supplying a continuous flow of supercritical state cleaning fluid from the mixing chamber through the cleaning chamber)**, that is it would make the continuous supercritical flow process of Inoue et al. **inoperable** (see col 3, lines 9-21.

"If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious." *In re Ratti, 270 F.2d 810, 123, USPQ 349 (CCPA 1959).*

"If proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." *In re Gordon, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).*

Further with respect to claim 3, Examiner asserts without any support that "it is **well known** in the art to circulate the cleaning solution in the chamber to reach every components of the substrate". Applicants respectfully request that Examiner

provide support for this assertion. In addition, even if Examiner were able to supply support for his assertion, such a fact would not help Examiner in producing Applicants invention.

"The fact that references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a prima facie case of obviousness without some objective reason to combine the teachings of the references." *Ex parte Levengood, 28 USPQ2d 1300 (Bd. Pat. App. & Inter. 1993).*

"**First**, there must be some **suggestion or motivation**, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. **Second**, there must be a **reasonable expectation of success**. **Finally**, the prior art reference (or references when combined) **must teach or suggest all the claim limitations**. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure." *In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).*

Further with respect to claims 7 and 9 Inoue et al. nowhere disclose:

"wherein said supercritical cleaning fluid is non-conductive."

Or

"wherein said cleaning fluid is selected from the group consisting of methane, ethane, propane, ammonia, nitric oxide, fluoromethane and difluoromethane."

2. Claims 10-13, 15, 17, 19-20 and 22-26 stand rejected under 35 USC 103(a) as being unpatentable over Inoue et al., above, in view of Morita et al. (2002/0083959) and Vasartstra (6,242,165).

Applicants reiterate the comments made above with respect to Inoue et al.

Even assuming *arguendo* a proper motivation for combination, the fact that Morita et al. disclose forming a high dielectric

constant film (BST) on a platinum thin film and then removing residual carbon compounds by supercritical carbon dioxide (or any substance other than carbon dioxide that has a sufficiently high ability to dissolve carbon compounds including water (see Abstract paragraph 0028; 0029; 0081; 0087)), does not further help Examiner in producing Applicants invention.

Applicants further note that the broad catch-all disclosure in paragraph 0089 also does not further help Examiner in providing any motive to modify Inoue et al. to achieve Applicants invention, and does not produce Applicants invention:

[0089] The inventive method is applicable to removing foreign matter from not only the dielectric film in a semiconductor device but also a conductor film or a semiconductor substrate in a semiconductor device or a component in a device of any other type. This is because the same effects **may** be attained in those cases **under appropriate conditions.**

In further contrast, Vaartstra discloses a method for removing organic material from a substrate using a **supercritical etching composition** including carbon dioxide and an oxidizer in a supercritical state where a nonsupercritical additive may be added to a chamber where the substrate is being exposed to a supercritical oxidizer (col 6, lines 23-37). The composition in a supercritical state is introduced into a pressureizeable chamber

where the pressure and temperature are controlled **for maintaining at least one component of the composition in a supercritical state** (col 3, lines 49-63).

Vaartstra et al. disclose that a supercritical fluid component e.g., CO2 in the supercritical state may be added to a supercritical oxidizer; or a component not in a supercritical state may be added to a supercritical component either before or after it is brought into the supercritical state; or a component not in a supercritical state may be provided into an etching chamber while the substrate is being exposed to the supercritical oxidizer component (col 6, lines 23-38). Vaartstra et al. also disclose that CO2 may be in a supercritical state while the oxidizer is not in a supercritical state (col 7, lines 64-66).

Vaartstra et al. also disclose that a mixing manifold (122; Figure 2) is used to mix components prior to their entry into the pressure vessel (col 9, lines 8-11) **where the components are heated in the mixing manifold such that at least one component is in a supercritical state in the mixing manifold (col 9, lines 19-26) prior to entering the pressure vessel.**

Vaartstra et al. **alternatively** disclose that the components

may be separately plumbed (unmixed) into the pressure vessel where the components are then mixed and are then brought into the supercritical state (col 9, lines 31-35).

Further assuming *arguendo* a proper motivation for modifying the process of Inoue et al. with the disparate process of Vaartstra, and further assuming *arguendo* that such combination could be made without destroying the continuous supercritical flow process of Inoue et al. and making it unsuitable for its intended purpose, (which Applicants do not concede and maintain such modification is impermissible as a matter of law), the further fact that Vaartstra discloses that a substrate assembly may included different substrates including silicon-on-sapphire technology (SOS), silicon-on-insulator technology (SOI), **doped and undoped semiconductors**, epitaxial layers on silicon etc. (see col 4, lines 30-49), does not further help Examiner in producing Applicants invention.

"**First**, there must be some **suggestion or motivation**, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. **Second**, there must be a **reasonable expectation of success**. **Finally**, the prior art

reference (or references when combined) **must teach or suggest all the claim limitations**. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure." *In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)*.

Conclusion

The cited references both individually or in combination, fail to produce Applicants invention and are therefore insufficient to make out a *prima facie* case of obviousness.

The claims have been amended to overcome Examiner rejections. A favorable consideration of Applicants' claims is respectfully requested.

Based on the foregoing, Applicants respectfully submit that the Claims are now in condition for allowance. Such favorable action by the Examiner at an early date is respectfully solicited.

In the event that the present invention as claimed is not in

condition for allowance for any reason, the Examiner is respectfully invited to call the Applicants' representative at his Bloomfield Hills, Michigan office at (248) 540-4040 such that necessary action may be taken to place the application in a condition for allowance.

Respectfully submitted,

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